Learning Theories Summary

Warren Carpani

ARCS:

This learning theory asserts that there are four major steps for motivating students: Attention, Relevance, Confidence, and Satisfaction. In the first stage, the attention of the student is gained through means such as surprise, uncertainty, active participation, humour, etc. In the second stage, concrete examples and connections to previous knowledge is used to convince students of both the present and future usefulness of the new knowledge. In the third stage, student confidence is built by providing clear success criteria and descriptive feedback and allowing learners to progress step by step. The final step is to make the student feel satisfied through either intrinsic or extrinsic means.

Why it's useful in math:

- Many students lack confidence in their abilities so I think it's important that teachers address this by properly sequencing problems (i.e. from easy to difficult and from concrete to more abstract)
- Allowing students to experience success (in the confidence stage) will make it more motivating for them to attempt more challenging problems
- In the relevance stage, problems and concepts should be given with context as much as possible (connections to the real world and to previously learned concepts)

Cognitive Apprenticeship:

This theory asserts that modeling, observation, and imitation are central to learning. When teaching a new skill, the teacher first gives an explicit example or demonstration. The teacher then coaches the students as they attempt to do the skill on their own (with scaffolding). Students are encouraged to clearly articulate the steps they use and explain their thinking, then reflect on their thinking by comparing their steps to those of the teacher or their classmates. Finally, students are given the opportunity to explore by solving more challenging problems, developing theories of their own, or researching further concepts.

Why it's useful in math:

- A concrete example is easier for students to understand than abstract concepts
- Many problems in mathematics require a number of steps to be completed in order
- Explaining steps to other students has been shown to be an effective learning activity (reciprocal teaching and peer tutoring are both high on Hattie's list of effective strategies)

ADDIE Model:

ADDIE is an acronym that stands for Analysis, Design, Development, Implementation, and Evaluation. First, the learning outcomes must be determined. Consideration is given to students' prior knowledge and to the learning environment. In the design and development stages, the teacher creates the content and learning materials. Next, the learning materials and content is distributed to students. The final stage consists of both summative and formative assessment.

Why it's useful in math:

- Since many concepts in mathematics require a large number of prerequisite skills, the analysis stage is crucial (i.e. proving a trigonometric identity requires familiarity with primary trigonometric ratios, factoring, grouping of like terms, cancellation, order of operations, reciprocals, etc.)
- Formative assessment allows students to focus on the areas where they need the most improvement, and also allows the teacher to assess and adjust the delivery of the material

Problem-based Learning:

In this learning theory, the teacher acts as a facilitator while students attempt to solve open-ended problems. The problems may be vague or poorly defined and may have many possible solutions. This learning theory aims to avoid memorization and work towards applying new knowledge in different contexts. The emphasis is on building problem solving skills and using them in meaningful ways.

Why it's useful in math:

- This theory is very similar to the one discussed in the Dan Meyer video we watched last semester
- Many textbook problems provide too much information to students, often requiring them only to pick out information from a statement and put it into a previously known formula
- Allowing students to develop their own approaches to solving problems that are missing information builds important skills such as estimation, making assumptions, and checking to see if answers are realistic
- The teacher (or the students themselves) can select problems that are more relevant. Many students will have different answers which can be discussed as a class

Visual Representation of Theories